

WATERSHED RESTORATION AND PROTECTION STRATEGY FOR THE MARAIS DES CYGNES BASIN

July, 2003

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FORWARD

This report is designed and offered as a resource to local groups and public officials in the Marais des Cygnes River Basin, who are looking for ways to start water pollution clean-up and restoration activities.

A wealth of information and policy direction is available and offered here from State of Kansas agencies and other resources, in an effort to bring focus to both emerging and sometimes critical, water quality and quantity issues affecting the public good.

This is the Watershed Restoration and Protection Strategy (WRAPS) for the Marais des Cygnes Basin. In response to the WRAPS philosophy of agency and stakeholder cooperation for improving water quality, the Kansas Department of Health and Environment (KDHE) provided a grant to Lake Region Resource Conservation and Development to facilitate a process to develop a long-term nonpoint source strategy for the basin.

The introduction will discuss water quality issues and the organization of this report information. This report has four chapters, representing the watersheds in the basin (hydrologic units). Priority lakes and stream sections are identified that must be protected to support water delivery to households, livestock, cities, industry, recreational needs and aquatic life support. Water quality problems and locations are identified and corrective measures recommended.

Based on the KDHE Basin reports for Total Maximum Daily Load (TMDL), it is also clear, that several stream segments and lakes are not currently meeting their designated uses. All citizens living in the basin must work together to protect available water for current and future generations to maintain our quality of life.

This report includes the latest in geographic watershed maps, reports, and reference materials, all designed to help the professional and non-professional alike to better understand water quality issues of the Marais des Cygnes Basin. In addition, there is information on what is needed and “at stake” for future water management to preserve and improve quality of life for the people who choose to live in the Marais Des Cygnes Basin.

INTRODUCTION

Watershed Setting

The Marais des Cygnes River Basin is an important natural resource covering 4,304 square miles in east central and southeast Kansas (Figure 1). Approximately 125,000 people in 13 counties depend on the watershed for drinking water, recreational opportunities, and agricultural production. The basin also provides critical habitat for wildlife that includes the Marais des Cygnes Wildlife Management Area, a natural wetland-providing habitat for migratory birds.

The Marais des Cygnes Basin includes four sub-watersheds the Upper Marais des Cygnes (HUC 10290101); Lower Marais des Cygnes (HUC 10290102); Little Osage (HUC 10290103); and the Marmaton (HUC 10290104). At the start of each of the four sub-basin chapters, there is a map and watershed description summary referenced from the KDHE's most recent Watershed Status Report. Please note; land use percentages and other statistics may vary slightly from other quoted documents due to updated GIS mapping.

The basin is characterized by increasing urban development expanding from the Kansas City metro area to the north. An additional 50,000 people are expected to reside in the watershed by 2040. This growth has and will result in increasing demands for housing, recreational opportunities, and drinking water. Despite the continuing urban growth, the Marais des Cygnes watershed maintains a robust agricultural industry comprised of feed grain operations, grazinglands, and confined animal feeding operations.

Major surface water resources in the basin include the Marais des Cygnes River and its major tributaries and three reservoirs: Pomona Lake, Melvern Lake, and Hillsdale Lake.

Water quality impairments in the basin's streams primarily are dissolved oxygen, nutrient loading, and fecal coliform bacteria. Low dissolved oxygen levels typically coincide with an abundance of algae and are associated with heavy organic matter and nutrients. The source of fecal coliform bacteria is waste from humans and other warm-blooded animals. Water quality problems in the basin's lakes include eutrophication, excessive biomass, and sediment. Eutrophication is caused by excessive nutrients from a variety of nitrogen and phosphorus sources and sediment. Potential sources of these impairments are livestock, municipal wastewater treatment, residential septic systems, failing streambanks, cropland, stormwater runoff, and naturally occurring sources.

Purpose and Scope of Report

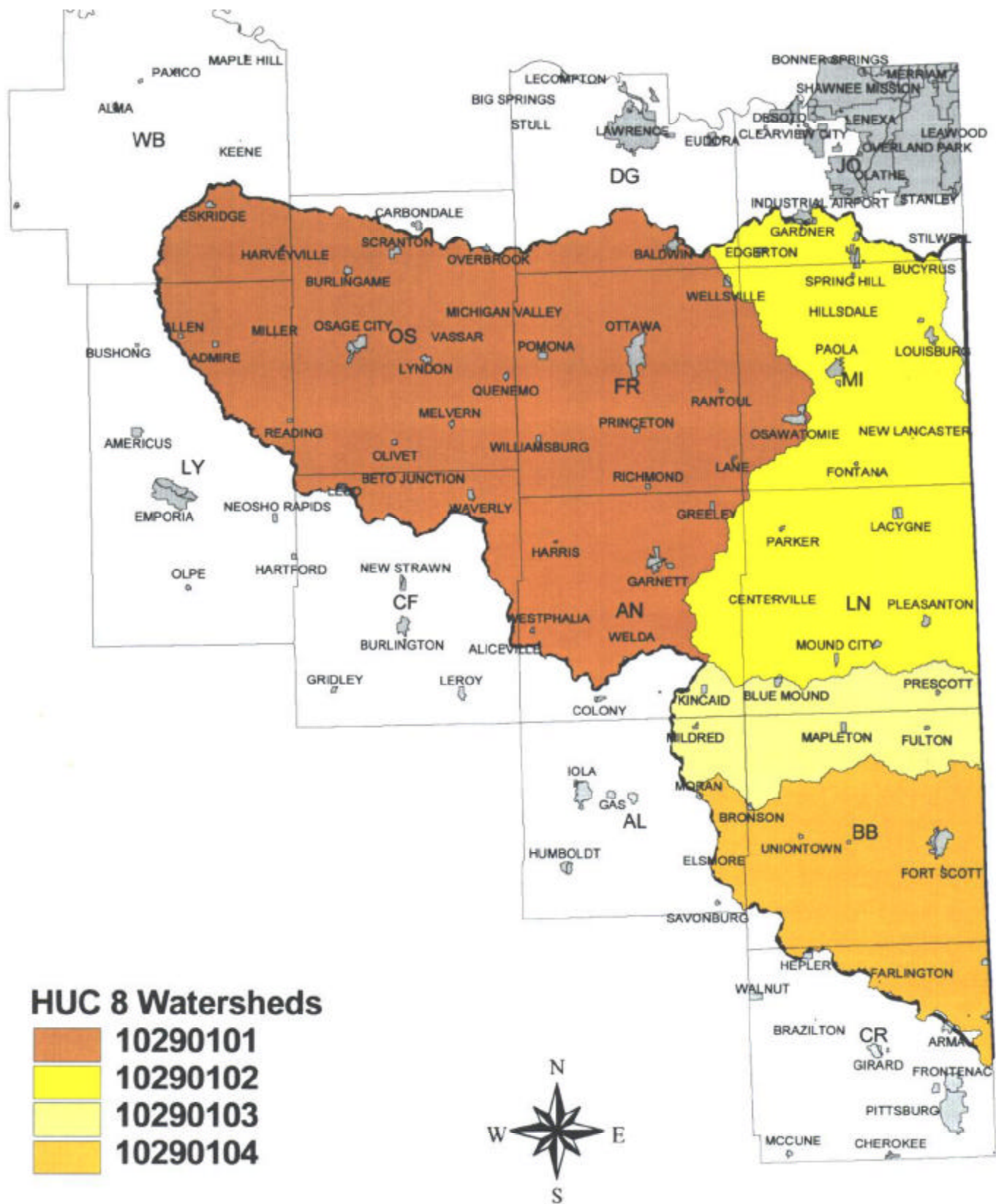
The purpose of the WRAPS effort is to outline a plan to: (1) restore the health of water resources in the basin that do not meet water quality standards; and (2) to ensure that water resources in the basin that currently meet water quality standards are protected.

The process of developing a WRAPS generally involves the following steps:

- 1) Identify the critical or priority water resources within the basin
- 2) Determine the condition of these critical or priority water resources
- 3) Establish water quality goals for these critical or priority water resources and
- 4) Identify water quality protection measures or actions (best management practices) needed to achieve the goals and objective.

Water quality goals are typically characterized as either "restoration goals" or "protection goals". Restoration goals apply to water resources that do not meet water quality standards (i.e. resources for which a TMDL has been established). Protection goals apply to water resources that currently meet water quality standards and need to be protected from further degradation.

This report addresses only surface water resources. Information about groundwater resources is available in the Watershed Condition Reports Appendix B.



Public Participation

The WRAPS planning effort was designed to hold five public meetings to collect and create an action plan for the basin. As a result of this effort public meetings were held in Osage City, Ottawa and Garnett. A fourth public meeting was held in Fort Scott in the Lower Marais des Cygnes Basin and meeting notices were sent out to a total of 279 individuals, agencies, cities, rural water districts and county conservation districts. News releases were sent to 12 newspapers and radio stations within the basin advising of the upcoming public meetings. All meetings were tape-recorded, and one of the meetings was videotaped for future reference.

The fifth public meeting, held in Ottawa, was a joint/cooperative effort between Lake Region RC&D and Kansas State University. The workshop titled "*We All Live Downstream: Protecting Water Quality in the Marais des Cygnes Watershed*" targeted local decision-makers and residents who have the potential to impact water quality in the basin. The event consisted of two field tours and a public workshop. Approximately 25 people participated in *Exploring the Impacts of Agriculture on Water Quality*, a field tour presented in cooperation with the K-State Research and Extension and the Natural Resources Conservation Service that provided a guided tour, discussion, and demonstration of an Integrated Agricultural Management System research site developing agricultural best management practices to achieve TMDL goals in the Marais des Cygnes Basin. Approximately 25 residents of the basin also participated in the *Exploring the Impacts of Urban Development on Water Quality* field tour presented in cooperation with the Hillsdale Water Quality Project. The program included a guided tour and discussion of water quality issues in the urbanizing Hillsdale Lake watershed. The event concluded with a public workshop that offered participants an opportunity to learn more about why water quality is important, sources and issues impacting water quality in the basin, how water quality issues are addressed in Kansas, and the role of TMDLs in achieving water quality goals. Presenters at the workshop represented a variety of agencies, including KDHE, K-State Research and Extension, State Conservation Commission, and Hillsdale Water Quality Project. Workshop participants also provided input into the development of this WRAPS through small group discussions that focused on identifying critical water resources, developing water quality protection goals, and recommending practices to protect or restore water resources.

Through these public participation opportunities, basin residents identified the following watershed restoration and protection goals:

1. Improve education of residents regarding sources of nonpoint source contaminants and changes needed to improve water quality in the basin;
2. Reduce fecal coliform bacteria, nutrient, organic matter, and sediment loading by improving: livestock manure management; tillage practices, fertilizer and pesticide management and crop rotations; riparian and buffer strip establishment and maintenance; home on-site waste management systems and education of homeowners; and stormwater runoff management;
3. Promote recreational activities that have limited water quality impacts to improve awareness of and appreciation for water resources;
4. Maintain fishing, aquatic, and wildlife habitats
5. Enhance cooperation between water suppliers to promote water quantity conservation; and
6. Identify the most important pollutant contributing areas and their sources.

Potential Pollution Sources in the Basin

There are a variety of potential pollution sources in the Marais des Cygnes Basin, representing a wide range of both urban and rural activities.

Row crop agriculture can be a significant source of nonpoint source pollution. Common pollutants from row crop agriculture include sediment, nutrients, pesticides, and fecal coliform bacteria. Many producers within the basin regularly implement and maintain Best Management Practices (BMPs) to limit the amount of nonpoint source pollutants leaving their farm. Some common BMPs include use of contour farming; use of cover crops; maintaining buffer strips along field edges; and proper timing and incorporation of fertilizer and herbicide application.

Many urban landscapes are covered by paved surfaces including roads, driveways, parking lots, and sidewalks. These surfaces are impermeable and tend to divert water into storm drains at high velocities. This increased flow velocity from urban areas can cause severe stream bank erosion in receiving water bodies. Additionally, urban and suburban runoff may carry other pollutants like petroleum hydrocarbons and heavy metals. Limiting paved surfaces is the key to slowing urban nonpoint source pollution. The use of grass swales, open spaces, and storm water retention ponds are recommended to slow runoff in urban areas. The basin has an increasing population living in suburban areas. Residential landscapes are often designed with large turf areas, which use high amounts of water and chemicals to maintain. The use of excessive amounts of fertilizers and lawn care chemicals in residential areas can contribute a significant amount of pollution to nearby water resources. Suburban nonpoint source pollution can be limited by: using less lawn fertilizers and chemicals by following recommended rates; controlling of construction sites; properly disposing of pet waste; establishing large areas of native vegetation; and conserving the amount of water use for plant maintenance.

In Kansas, confined animal feeding operations (CAFOs) with greater than 300 animal units must register with KDHE. Waste disposal practices and wastewater effluent quality are monitored by KDHE for these registered CAFOs to determine the need for runoff control practices or structures. Because of this monitoring, registered CAFOs are not considered a significant threat to water resources within the basin. A portion of the State's livestock population exists on small-unregistered farms. These small, unregistered livestock operations may contribute a significant source of fecal coliform bacteria and nutrients, depending on the presence and condition of waste management systems and proximity to water resources. Information about permitted feedlots in the Marais des Cygnes Basin is included in the Watershed Condition Reports Appendix B.

Municipal and industrial wastewater treatment facilities are regulated by KDHE through National Pollutant Discharge Elimination System (NPDES) permits. These permits specify the maximum amount of pollutants that can be discharged into surface waters. Due to the chlorination processes involved in municipal waste treatment, these facilities are not considered to be a significant source of fecal coliform bacteria; however they may be a significant source of nutrients. Information about permitted wastewater treatment facilities in the MARAIS DES CYGNES Basin is included in the Watershed Condition Reports Appendix B.

There are currently hundreds of septic systems within the watershed and this number is increasing. When properly designed, installed, and maintained, septic systems can act as an effective means of wastewater treatment. However; poorly maintained or "failing" septic systems can leach pollutants into nearby surface waters and groundwater. The exact number of failing septic systems within the basin is unknown. However; the number may be increasing due to the current trends in suburban development. Local Environmental Protection Programs and county health departments provide excellent sources of information regarding the proper design, installation, and maintenance for septic systems.

Wildlife located throughout the watershed is not usually considered a significant source of nonpoint source pollutants. However, during seasonal migrations, concentrations of waterfowl can add significant amounts of fecal coliform bacteria and nutrients to surface water resources.

Policy – State Agency Responsibility and Managing Basin Water Resources

The WRAPS focuses on water quality, but these issues must be kept in perspective with demands for water uses and insure adequate public supplies.

The Kansas Water Office (KWO) is responsible for developing the Kansas Water Plan, the tool used in Kansas to address current water issues and to plan for future water quality and quantity needs. This plan was developed with focused assistance of some 23 key Kansas agencies and organizations, plus oversight review and approval of the Kansas Water Authority. For further information please see Appendix D-I for a draft copy of the Kansas Water Plan for Year 2005 and a copy of the State of Kansas 2002 Status Report D-II concerning 1) Water Marketing Program; 2) Water Assurance Program; 3) Multipurpose Small Lakes Program. Also in Appendix D-III is a draft copy of the KWO 2005 on Kansas Water Quality Policy. Additional information can be found on these subjects on the KWO web site: <http://www.kwo.org/>.

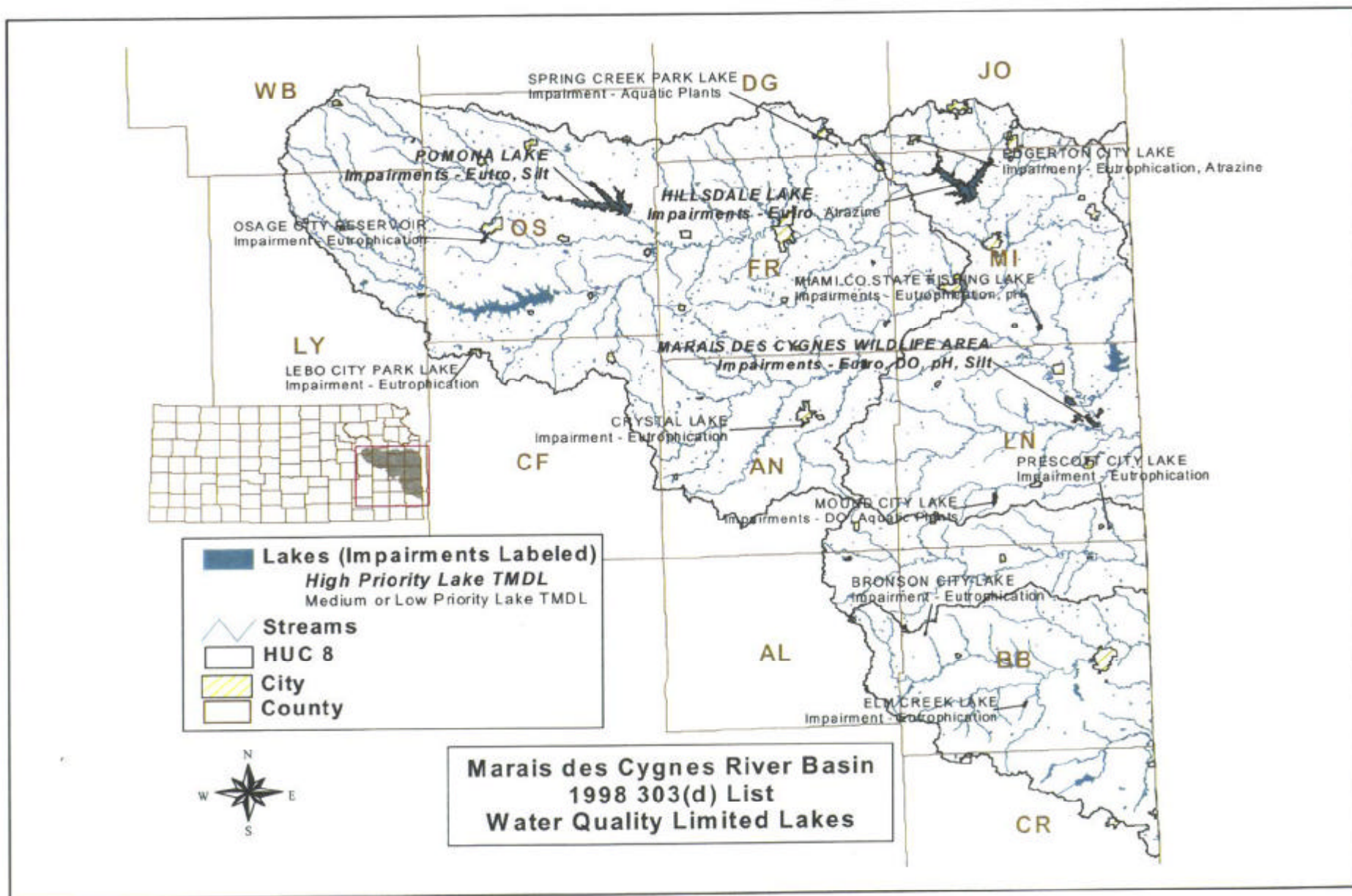


Figure 2

SECTION 1

UPPER MARAIS DES CYGNES

HUC 8 (10290101)

**UPPER MARAIS DES CYGNES (HUC 10290101)
WATERSHED RESTORATION and PROTECTION STRATEGY**

I. WATERSHED SETTING

Location

The Upper Marais des Cygnes Watershed is comprised of 200.02 square miles and is located in East Central Kansas within Franklin, Osage, Anderson, Coffey, Lyon, Wabaunsee, Douglas and Miami counties (Figure 3). There are approximately 1,223 stream miles and 1,536 acres of lakes.

Water Resources

The Upper Marais des Cygnes Watershed is mostly a drainage basin for the Marais des Cygnes River, however; smaller streams and creeks are also abundant throughout the area. The Marais des Cygnes River, Hundred and Ten Mile Creek, One Hundred Forty Two Mile Creek, Dragoon Creek, Ottawa Creek, Pottawatomie Creek, Salt Creek and Walnut Creek are a few of the larger streams and rivers in the watershed.

This watershed contains two Federal reservoirs; Melvern Lake and Pomona Lake. Other smaller lakes in the watershed include Cedar Creek Lake, Lyon County State Fishing Lake, Osawatomie City Lake, Osage County Fishing Lake, Lyndon City Lake, Garnett Lake, Richmond City Lake, Spring Creek Park Lake and Osage City Reservoir. There is also one wetland called the Melvern Wetland Area.

Land Use

The primary land use in the watershed is grassland (considered grazingland for livestock), which comprises 56% of the watershed. Cropland occupies 31% of the watershed; forest/woodland 9%; surface water 1%; urban land uses 1% and wetland 1%. Analyzing the land uses within this watershed helps to understand which land uses might have greater influences on the source of the impairments (Figure 4).

Water Uses

The most common designated uses for streams and rivers in this watershed include aquatic life uses, food procurement, domestic water supply, livestock water supply, groundwater recharge, irrigation use and contact recreational use. According to the Kansas Surface Water Register, there are approximately 106 public water supply wells within the watershed, many of which draw water from the Marais des Cygnes River and its alluvium. The majority of the lakes in this watershed are designated for food procurement, expected aquatic life, domestic water supply, contact recreation and recreational purposes. There are approximately 694 groundwater wells located within this watershed. Water from these wells is used for domestic use, monitoring wells, public water supply, feedlots, lawns and gardens. Alluvial aquifers of the Marais des Cygnes River provide the primary water source for many public water supplies located within this watershed. Portions of the Douglas aquifer exist in the southwestern portion of the watershed. Water from this aquifer is also used for rural domestic water supply, food procurement, recreational activities and expected aquatic use.

Overview of Water Quality

The Upper Marais des Cygnes Watershed is ranked fifth in state priority for watershed restoration throughout the state according to the Unified Watershed Assessment completed by KDHE in 1998.

Water quality in the Upper Marais des Cygnes streams and rivers is generally fair with less than half of the surface water bodies not meeting their designated uses. Approximately 38% of the stream/river segments sampled require TMDL restoration. The primary pollutant concern within this watershed is Dissolved Oxygen.

Approximately 33% of the lakes in this watershed need TMDLs. The primary pollutant concern for lakes within this watershed is eutrophication. Additional pollutant concerns for lakes within the watershed include excessive biomass and silt.

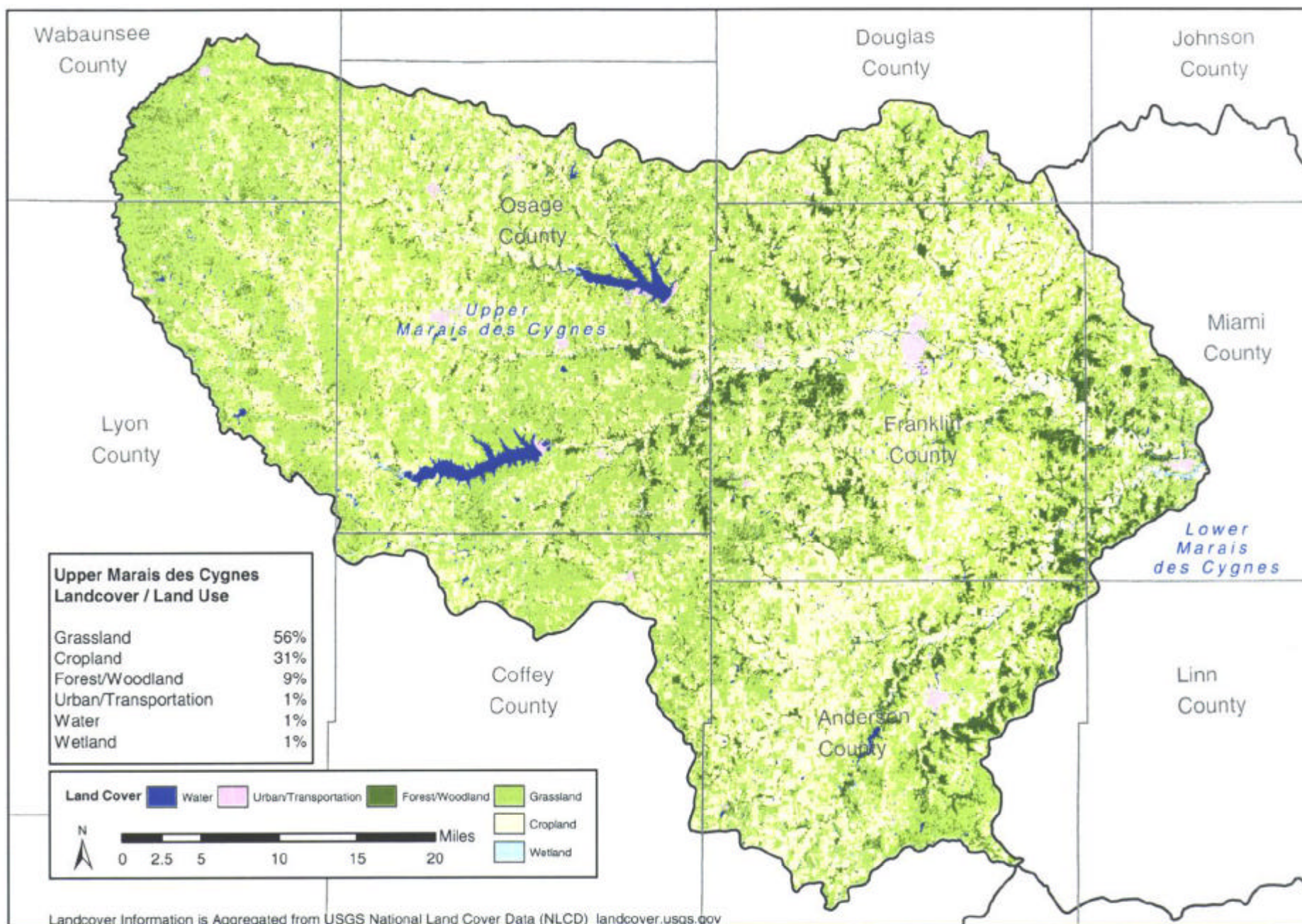


Figure 4

Information about KDHE monitoring sites, within the watershed, can be located at KDHE Bureau of Environmental Services (Appendix C for contact information). Potential Sources of Pollution can be found in the introduction section of this report.

II. PRIORITY WATER RESOURCES

For the purpose of this report, “priority water resources” are defined as surface water resources with the following designated uses: domestic water supply, primary contact recreation, special aquatic life support and/or food procurement. Priority water resources include resources in need of restoration and those in need of protection.

Priority water resources in the Upper Marais des Cygnes Watershed are summarized in Table 1 and illustrated in Figure 3.

TABLE 1: Priority Water Resources in the Upper Marais des Cygnes Watershed

Rivers and Streams

Water Source	Designated Uses	Drinking Water Supply Source
Rivers and Streams		
Appanoose Creek	SAL, FP	
Marais des Cygnes River	SAL, PCR, DS, FP, GR, IS, IR, LW	Franklin RWD 1,2,4,6 and 7, Ottawa, Rantoul, Lane, Princeton, Melvern, Osage City, Osage RWD 7
Dragoon Creek	EAL, FP, DS, GR, IS, IR, LW, PCR	Burlingame
Coal Creek	EAL, FP, DS	Lebo
110 Mile Creek	EAL, DS, FP, GR, IS, IR, LW, PCR	
Pottawatomie Creek	SAL, FP, GR, IR, LW, PCR, DS	
142 Mile Creek/ Marais des Cygnes River	EAL, FP, GR, IW, LW, PCR, IR	
Ottawa Creek (Taui Creek)	SAL, SCR, FP	
Salt Creek	EAL, FP, DS	Lyndon

Lakes and Wetlands

Water Source	Designated Uses	Drinking Water Supply
Lakes and Wetlands		
Melvern Lake	EAL, FP, DS, PCR,	PWWSD 12 (Burlingame Lebo, Lyndon, Melvern Osage RWD 4, Pomona Quenemo, Waverly, Williamsburg
Pomona Lake	EAL, FP, DS, PCR, SCR, IW	Osage RWD #3 and 9
Crystal Lake	SCR, EAL, DS, FP, IW	Garnett
Cedar Creek Lake	EAL, FP, DS	Garnett, Greeley Anderson RWD #1, 4, 6
Richmond City Lake	EAL, FP, DS,	Richmond Anderson RWD #3 and 4
Westphalia City Lake	EAL, FP, DS	Anderson RWD #2

Key:

SAL – Special Aquatic Life Support
 EAL – Expected Aquatic Life Support
 PCR – Primary Contact Recreation
 SCR – Secondary Contact Recreation
 DS – Domestic Water Supply
 FP – Food Procurement
 GR – Groundwater Recharge
 IW – Industrial Water Supply
 IR – Irrigation
 LW – Livestock Watering

III WATER QUALITY CONDITONS

Rivers and Streams

Water quality in streams and rivers is generally fair with less than half of the surface water bodies not meeting their designated uses. Approximately 38% of the stream/river segments sampled require TMDL restoration (Figure 3).

Low levels typically coincide with an abundance of algae, which may be caused by excess nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up the water oxygen required for aquatic life support. Potential nutrient sources causing dissolved oxygen include feedlots, streamside feeding of livestock, wastewater treatment facilities, septic systems and wildlife.

Rivers and Streams in Need of Restoration

Hundred and Ten Mile Creek - Aquatic life in certain segments of Hundred and Ten Mile Creek are impaired due to low levels of dissolved oxygen. Low dissolved oxygen levels typically coincide with an abundance of algae, which may be caused by excess nutrients. Nonpoint sources appear to be the contributing factor to the low levels in the creek. Extensive improvements in tributary buffer strip conditions will help filter sediment and result in implementation of corrective actions. More information about the TMDL for Hundred and Ten Mile Creek is available Appendix C.

Marais des Cygnes River – The goal for the Marais des Cygnes River will be for improvements that will support Primary Contact Recreation and Secondary Contact Recreation. Implementation of corrective actions and BMP's to address the primary pollutant concern of fecal coliform bacteria, which is an indicator of potential disease causing organisms, will be the endpoint to achieve Kansas Water Quality Standards.

Marais des Cygnes River/142 Mile Creek – Aquatic life functions and Primary Contact Recreation of this creek are impaired due to low levels of dissolved oxygen and concentrations of fecal coliform bacteria. Expected outcomes for this creek will be achieved by reductions in loading from the various sources in the watershed implementing Best Management Practices.

Pottawatomie Creek – Aquatic life in certain segments of the Pottawatomie Creek are impaired due to low levels of dissolved oxygen and biochemical oxygen demand (BOD). The Little Osage River watershed and Big Sugar Creek watershed were used as comparisons as they have similar land use characteristics, are of similar size and are located near the Pottawatomie Creek watershed. It was determined that these two watersheds were not impaired by low dissolved oxygen. Desired endpoint will be to improve dissolved oxygen concentrations in the creek at critical lower flows and reductions in organic loading using Best Management Practices. More information about the TMDL for Pottawatomie Creek is available in Appendix C.

Dragoon Creek – Aquatic life in certain segments of Dragoon Creek is impaired due to low levels of dissolved oxygen. Low dissolved oxygen levels typically coincide with an abundance of algae, which may be caused by excess nutrients. Nonpoint pollution sources appear to be the contributing factor to the low levels in the creek. Reduction in organic loading will be achieved by using implementing corrective actions and Best Management Practices. More information about the TMDL for Dragoon Creek is available in Appendix C.

Ottawa Creek – Aquatic life in certain segments of Ottawa Creek is impaired due to low levels of dissolved oxygen and is, therefore, sensitive to the low flow conditions. Low dissolved oxygen levels typically coincide with an abundance of algae, which may be caused by excess nutrients. Nonpoint pollution sources appear to be the contributing factor to the low dissolved oxygen levels in the creek. Improvements in tributary buffer strip conditions will help filter sediment to reduce SOD and consequently improve dissolved oxygen during critical periods of concern. More information about the TMDL for Ottawa Creek is available in Appendix C.

Lakes and Wetlands

Approximately 33% of the lakes in this watershed need TMDLs. Primary pollutant concern for lakes within this watershed is eutrophication. Additional pollutant concerns for lakes within the watershed include excessive biomass and silt loading. Approximately 71% of the lakes in the watershed are eutrophic, 14% have low dissolved oxygen levels (Figure 2).

Eutrophication is a natural process that creates conditions favorable for algae blooms and excess plant growth. Excessive nutrient loading often accelerates this process in the watershed. Low dissolved oxygen levels typically coincide with the abundance of algae, which may be caused by excess nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up oxygen. pH determines the alkalinity or acidity of water in the lake. If the water is too basic or acidic it can potentially stress or kill the aquatic life and vegetation. Excessive biomass is an abundance of vascular plants that tends to be a nuisance and interferes with designated water uses. Insufficient flow can cause the stream to have a high temperature, low dissolved oxygen, and increase pollutant concentrations. Silt loading is a result of erosion as soil particles enter the lake and settles to the bottom. Silt decreases water clarity and eventually decreases water storage capacity. Silt also carries attached phosphorous into the reservoir, which can accelerate eutrophication. Potential sources of excess nutrients are row crop agriculture, feedlots, streamside feeding of livestock, septic systems, overgrazed land, urban/suburban runoff and municipal wastewater treatment plants. More information about potential pollution sources in the watershed is included in the introduction.

Lakes in Need of Restoration

Pomona Lake – All designated uses in the lake are impaired to a degree by eutrophication. Phosphorus is the primary limiting factor. Surface water in Pomona Lake has high turbidity, dominated by inorganic materials because the lake receives a steady inflow of silt. It appears that the majority of the nutrient load is coming from the Dragoon Creek sub-watershed. The One Hundred Ten Mile sub-watershed is contributing an intermediate amount to the total nutrient load. The watershed immediately around the lake has a high potential for nonpoint source pollutants. One source of phosphorus is probably runoff from agricultural lands where phosphorus has been applied. Just over 35.4% of the lake's watershed are comprised of cropland. There is an expected population increase in the watershed between 2003 and 2020. More information about the TMDL for Pomona Lake is available in Appendix C.

Crystal Lake – All designated uses are impaired to a degree by eutrophication. A source of phosphorus within the watershed is surface runoff from agricultural lands where fertilizer is applied to cropland. Land coverage in the drainage area of Crystal Lake is 11.5% cropland and 49.9% grassland. Desired activities to reduce nonpoint source nutrient loads can be implemented by using Best Management Practices. More information about the TMDL for Crystal Lake is available in Appendix C.

Table 2: Priority Water Resources Requiring TMDLs

Upper Marais des Cygnes			
Water Resource	TMDL	Implementation Priority	Annual Pollutant Load Reduction Target
Rivers and Streams:			
Hundred and Ten Mile Creek	Dissolved Oxygen	High	Not specified
Marais des Cygnes River	Fecal Coliform Bacteria	High	Not specified
Marias des Cygnes River/ 142 Mile Creek	Fecal Coliform Bacteria	High	Not specified
	Dissolved Oxygen	High	BOD 38%
Pottawatomie Creek	Dissolved Oxygen	High	BOD 26%
Dragoon Creek	Dissolved Oxygen	High	BOD – 45%
Ottawa (Tauiy) Creek	Dissolved Oxygen	High	Not specified

Lakes and Wetlands:			
Crystal Lake	Eutrophication	Medium	
Pomona Lake	Eutrophication Siltation	High	Not specified

Sources:

Kansas Surface Water Register – June 1, 1999
KDHE Bureau of Environmental Services
<http://www.kdhe.state.ks.us/pdf/befs/register99.pdf>

Upper Marais des Cygnes Watershed Conditions Report
KDHE Watershed Management Section
http://www.kdhe.state.ks.us/nps/wc_reports/10290101/pdf

SECTION 2

LOWER MARAIS DES CYGNES HUC 8 (10290102)

LOWER MARAIS DES CYGNES (HUC 10290102) WATERSHED RESTORATION AND PROTECTION STRATEGY

I. WATERSHED SETTING

Location

The Lower Marais des Cygnes Watershed (HUC 10290102) is comprised of 1,602 square miles and is located in the central part of the Marais des Cygnes Basin (Figure 5).

Water Resources

The Lower Marais des Cygnes Watershed is mostly a drainage basin for the Marais des Cygnes River. Other larger streams in the watershed include Sugar Creek, Middle Creek, and Wea Creek. Hillsdale Lake is the only Federal reservoir in the watershed. Other large lakes include the La Cygnes Lake and the Marais des Cygnes Wildlife Management Area. Some of the smaller lakes in the watershed include Mound City Lake, Spring Hill City Lake, Louisburg State Fishing Lake, Miami County Fishing Lake and Pleasanton Lake. Major groundwater aquifers underlying the watershed include portions of the Ozark and Glacial Aquifer and alluvial aquifers of the Marais des Cygnes River and its tributaries.

Land Uses

Grassland (considered grazingland for livestock) is the primary land use (50%) in the watershed. Cropland occupies 26% of the watershed, forest/woodland areas 18%, surface water 2%, urban land uses comprise 1% and wetland 3% of the watershed (Figure 6).

Water Uses

The most common designated uses for streams and rivers in this watershed include aquatic life uses, food procurement; domestic water supply and groundwater recharge. There are approximately 26 public water supplies within the watershed, many of which draw water from the Marais des Cygnes River and its alluvium. The majority of the lakes in this watershed are designated for food procurement, expected aquatic life, industrial water supply, and domestic water supply. There are approximately 165 groundwater wells located within the watershed. Water from these wells is used for domestic use, groundwater monitoring, and urban uses (lawn and garden). Portions of the Ozark Aquifer exist in the southeastern portion of the watershed. Water from this aquifer is often used for rural domestic and public water supply. Portions of the Glacial Drift aquifer exist in the northern counties bordering the watershed.

Overview of Water Quality

The Lower Marais des Cygnes Watershed is ranked 12th in priority for watershed restoration throughout the state according to the Unified Watershed Assessment completed by (KDHE) in 1998.

Water quality in streams and rivers is generally in fair to good condition. Ten percent of total stream miles do not meet designated uses. Approximately 8% of stream/river segments sampled by KDHE require the establishment of Total Maximum Daily Loads (TMDLs). The primary pollutant concern for this watershed's streams and rivers is dissolved oxygen.

Approximately 29% of the watershed's lakes and wetland areas sampled need TMDLs. The primary pollutant concern for lakes within the watershed is eutrophication. Additional pollutant concerns for lakes within the watershed include pH, dissolved oxygen, atrazine, silt, and excess biomass.

Information obtained from monitoring sites within watershed is available from the KDHE Bureau of Environmental Field Services (Appendix C for contact information). Information about potential pollution sources in the watershed is included in the Introduction.

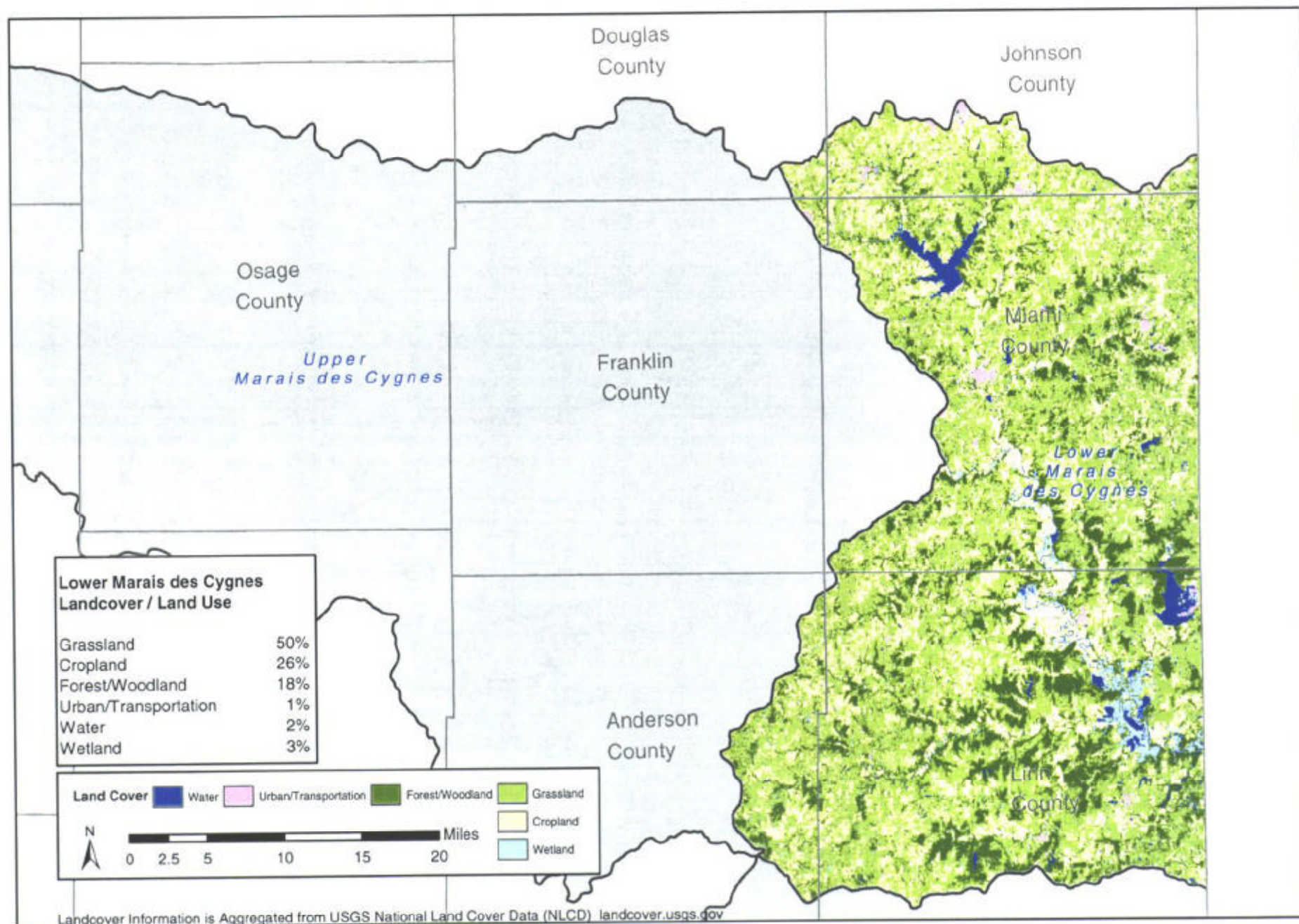


Figure 6

II. PRIORITY WATER RESOURCES

For the purposes of this report, “priority water resources” is defined as those surface water resources with the following designated uses: domestic water supply, primary contact recreation, special aquatic life support, and/or food procurement. Priority water resources include those resources in need of restoration and those in need of protection.

Priority water resources in the Lower Marais des Cygnes Watershed are summarized in Table 1 and illustrated in Figure 5.

TABLE 3: Priority Water Resources in the Lower Marais des Cygnes:

Water Resource	Designated Uses	Drinking Water Supply For:
Rivers and Streams:		
Big Sugar Creek	SAL, PCR, DS, FP, GR, IW, IR, LW	
Bull Creek	EAL, SCR, DS, FP, GR, IW, IR, LW	Paola, Miami RWD 1
Dorsey Creek	EAL, DS	
Little Bull Creek	EAL, DS, FP, GR, IW, IR, LW	
Little Sugar Creek	EAL, FP	Mound City
Marais des Cygnes	SAL, PCR, DS, FP, GR, IW, IR, LW	Franklin RWD 1, 2, 4, 6, and 7, Lane, Rantoul, LaCygne, Linn RWD 1 and 3, Melvern, Osage City, Osage RWD 7, Princeton, Osawatomie, Ottawa, Miami RWD 1 and 3,
Middle Creek	SAL, PCR, DS, FP, GR, IW, IR, LW	Linn Valley Lakes, Louisburg
Muddy Creek	SAL, PCR, DS, FP, GR, IW, IR, LW	
Rock Creek	EAL, DS	
Smith Branch	EAL, DS	
Spring Creek	EAL, DS, FP, GR, IW, IR, LW	
Sugar Creek	EAL, FP	
Sugar Creek North	SAL, PCR, DS, FP, GR, IW, IR, LW	
Wea Creek North	EAL, FP	
Wea Creek South	FP	

Lakes and Wetlands:		
Blue Mound City Lake	EAL, PCR, DS, FP, IS	Blue Mound
Edgerton City Lake	EAL, DS, FP, IS	Edgerton
Hillsdale Lake	SAL, PCR, DS, FP, IS	Spring Hill
La Cygne Lake	EAL, FP, IS	
Louisburg Old Lake	EAL, PCR, DS, FP, IS	Louisburg
Louisburg State Fishing Lake	EAL, DS, FP, IS	Louisburg
Marais des Cygnes National Wildlife Refuge	SAL, FP	
Marais des Cygnes Wildlife Area	SAL, FP	
Miami County State Fishing Lake	EAL, FP	
Miola Lake	EAL, PCR, DS, FP, IS	Paola, Miami RWD 1
Mound City Lake	AL, PCR, DS, FP, IS	Mound City
Paola City Lake	EAL, FP	
Parker City Lake	EAL, DS, FP, IS	Parker
Pleasanton Lake 1 and 2	EAL, DS, FP, IS	Pleasanton, Linn RWD 2
Pleasanton Reservoir	EAL, PCR, DS, FP, IS	
Spring Hill City Lake	EAL, DS, FP, IS	Spring Hill

Key:

SAL – Special Aquatic Life Support
 EAL – Expected Aquatic Life Support
 PCR – Primary Contact Recreation
 SCR – Secondary Contact Recreation
 DS – Domestic Water Supply
 FP – Food Procurement
 GR – Groundwater Recharge
 IW – Industrial Water Supply
 IR – Irrigation
 LW – Livestock Watering

III. WATER QUALITY CONDITIONS

Rivers and Streams

Surface water quality in streams and rivers is generally fair to good condition, with 10% of total stream miles not meeting designated uses. Approximately 8% of the stream/river segments sampled require TMDLs (Figure 5).

The primary pollutant concern for this watershed's streams and rivers is dissolved oxygen. Low dissolved oxygen levels typically coincide with an abundance of algae, which is often the result of excess

nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up the oxygen in the stream or river water column. Potential sources of excess nutrients include: row crop agriculture, feedlots, urban/suburban runoff, wastewater treatment facilities, septic systems, and wildlife. More information about potential pollution sources in the watershed is included in the Introduction.

Rivers and Streams in Need of Restoration

Middle Creek – Aquatic life in certain segments of Middle Creek is impaired due to low levels of dissolved oxygen. A comparison with another sampling site in the Little Osage Watershed to the south suggests that a significant nutrient load is being added to Middle Creek and is likely influencing the impairment. Nonpoint pollution sources, lack of stream flow, and high water temperatures appear to be the contributing factors. More information about the TMDL for Middle Creek is available in Appendix C.

Lakes and Wetlands

Approximately 29% of the watershed's lakes and wetland areas sampled need TMDLs. Primary pollutants for this watershed's lakes are eutrophication, dissolved oxygen levels, pH, atrazine, excess biomass, insufficient flow (Hydro), and silt loading. Approximately 36% of the lakes in the watershed are eutrophic, 14% have low dissolved oxygen levels, 14 % have either high or low pH, 14% are impaired by atrazine, 7% have excessive biomass, 7% have an insufficient flow, and 7% are impaired by silt loading (Figure 2).

Eutrophication is a natural process, which creates conditions favorable for algae blooms and excess plant growth. This process is often accelerated by excess nutrient loading from the watershed. Low dissolved oxygen levels typically coincide with an abundance of algae, which may be caused by excess nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up the oxygen in the stream or river. pH determines the alkalinity or acidity of water in the lake. If the water is too basic or acidic it can potentially stress or kill the aquatic life and vegetation. Atrazine is a common herbicide used to control grasses in corn and grain sorghum. Excessive biomass is an abundance of vascular plants that tends to be a nuisance and interferes with designated water uses. Insufficient flow can cause the stream to have a high temperature, low dissolved oxygen, and increase pollutant concentrations. Silt loading is a result of erosion as the bare soil enters the lake and settles to the bottom. Silt decreases water clarity and eventually decreases water storage capacity. Silt also carries phosphorous into the reservoir, which can accelerate eutrophication. Potential sources of excess nutrients include: feedlots, wastewater treatment facilities, septic systems, wildlife, agriculture and grazingland. Based on the watershed's land use percentages, the primary pollutant sources for nutrients would be row crop agriculture and feedlots. Additionally, municipal wastewater treatment plants and urban/suburban runoff may contribute significant amounts of nutrients into the watershed. More information about potential pollution sources in the watershed is included in the Introduction.

Lakes and Wetlands in Need of Restoration

Edgerton City Lake – Aquatic life support and domestic water supply uses in Edgerton City Lake are impaired due to high levels of atrazine. The watershed around the lake has a high potential for nonpoint source pollutants. The primary source of atrazine within the lake is probably runoff from agricultural lands where the herbicide has been applied. All designated uses in the lake are impaired to a degree by eutrophication. The lake is considered “hypereutrophic”, meaning that the lake is extremely or very highly eutrophic. One source of phosphorus within the lake is probably runoff from agricultural lands where phosphorus has been applied. Nearly 60% of the lake's watershed is comprised of cropland. Phosphorus from urban uses, animal waste, atmospheric phosphorus, and geological formations (i.e., soil and bedrock) may also be a contributing factor. More information about the TMDL for Edgerton City Lake is available in Appendix C.

Hillsdale Lake – All designated uses in the lake are impaired to a degree by eutrophication. Phosphorus is the primary limiting factor. The total phosphorus load is greatest in the Big Bull arm of the lake, which contributes 40 – 50% of the nonpoint source pollutants in the lake. Point sources within the watershed contribute an estimated 11% of the total phosphorus load. The watershed around the lake has a high potential for nonpoint source pollutants. One source of phosphorus within the lake is probably runoff from agricultural lands where phosphorus has been applied. Just over 35% of the lake's watershed is

comprised of cropland. Phosphorus from animal waste is a contributing factor. Half of the lake's watershed is comprised of grassland. Animal waste applied to land from confined animal feeding operations adds to the nitrogen and phosphorus load into the lake. Fertilizer applications to lawns and golf courses are likely sources of nutrient loading. The watershed is experiencing rapid urban growth, which means that pollutants from urban sources will continue to grow. Failing septic systems in the lake's watershed are also a likely contributing factor to the impairments. More information about the TMDL for Hillsdale Lake is available in Appendix C.

Marais des Cygnes Wildlife Management Area – Water quality information included for the Marais des Cygnes Wildlife Management Area is based on KDHE sampling activities in Unit G, and may not necessarily represent water quality conditions in the rest of the wildlife area. All designated uses in the management area are impaired to a degree by eutrophication. The lake is considered “hypereutrophic”, meaning that the lake is extremely or very highly eutrophic. The management area has a low potential for nonpoint source pollutants. One source of phosphorus within the management area is probably runoff from agricultural lands where phosphorus has been applied. Nearly 18% of the area's watershed is comprised of cropland. Phosphorus from animal waste is also a contributing factor. Over one-third (36%) of the area's watershed is comprised of grassland. Animal waste applied to land from confined animal feeding operations adds to the nitrogen and phosphorus load into the lake. Nutrient recycling from sediments in the wetland is another source of available phosphorus, along with waste from migrating waterfowl and other wildlife. Leaf litter is also a likely minor contributing factor given that 27% of the area's watershed is covered by woodland. The management area also has high levels of inorganic turbidity and siltation. The high concentration of total suspended solids is partially due to cropland, which comprises nearly 18% of the area's watershed. Also, soil from exposed land in the watershed runs off into the wetland, increasing the concentration of total suspended solids. Background levels of total suspended solids are also high, caused by geological sources, carp activity, and silt transported into the wetland from the Marais des Cygnes River during high water flow events. More information about the TMDL for the Marais des Cygnes Wildlife Management Area is available in Appendix C.

Miami County State Fishing Lake – All designated uses in the lake are impaired to a degree by eutrophication. The lake is considered “hypereutrophic”, meaning that the lake is extremely or very highly eutrophic. The lake has a low potential for nonpoint source pollutants. Phosphorus from animal waste is a contributing factor. Over half (56%) of the lake's watershed is comprised of grassland. Another source of phosphorus is probably runoff from agricultural lands where phosphorus has been applied. Waste from waterfowl and other types of wildlife also contribute phosphorus to the lake. Leaf litter may also be a minor contributing factor given that 24% of the watershed is covered by woodland. More information about the TMDL for Miami County State Fishing Lake is available in Appendix C.

Mound City Lake – All designated uses in the lake are impaired to a degree by eutrophication. Eighty percent of the lake is covered with aquatic plants. Decomposition of plant material has lowered dissolved oxygen concentrations in the lake, impairing aquatic life support. The lake has a moderate to high potential for nonpoint source pollutants. Phosphorus from animal waste is a primary contributing factor. Nearly 60% of the lake's watershed is comprised of grassland. Another source of phosphorus is probably runoff from agricultural lands where phosphorus has been applied. Just over 16% of the watershed is comprised of cropland. Fertilizer application to lawns within the watershed is another source of nutrient loading. Mound City is experiencing strong population growth, which means that pollutants from urban sources will continue to grow. Leaf litter may also be a minor contributing factor given that 21% of the lake's watershed is covered by woodland. More information about the TMDL for Mound City Lake is available in Appendix C.

IV. WATER QUALITY GOALS

The general goals associated with each priority water resource are to restore (for those water resources with a TMDL) or maintain (for those water resources in need of protection) water quality to fully support designated uses.

Restoration Goals

Rivers and Streams

Middle Creek – According to the TMDL for this water resource, the goal is to achieve the Kansas Water Quality Standard for dissolved oxygen to fully support aquatic life. To achieve this, biochemical oxygen demand must be reduced by 22% annually. More information about the TMDL for Middle Creek is available in Appendix C.

Lakes and Wetlands

Edgerton City Lake –Aquatic life support and domestic water supply uses in Edgerton City Lake are impaired due to high levels of atrazine and all designated uses in the lake are impaired to a degree by eutrophication. The watershed around the lake has a high potential for nonpoint source pollutants. The primary source of atrazine within the lake is probably runoff from agricultural lands where the herbicide has been applied. One source of phosphorus within the lake is probably runoff from agricultural lands where phosphorus has been applied. Nearly 60% of the lake's watershed is comprised of cropland. Phosphorus from urban uses, animal waste, atmospheric phosphorus, and geological formations (i.e., soil and bedrock) may also be a minor contributing factor. More information about the TMDLs for Edgerton City Lake is available in Appendix C.

Hillsdale Lake – According to the TMDL for this water resource, phosphorus loading from point sources must be reduced by 46% annually to achieve the annual limit of 10,148 pounds. Phosphorus loading from nonpoint sources must be limited to 64,244 pounds per year, an annual reduction of 46%.

Marais des Cygnes Wildlife Management Area – To achieve full support of designated uses in the management area, phosphorus loading must be limited to 3,770 pounds per year and nitrogen loading to 61,309 pounds per year. To achieve this target, phosphorus loading into the lake must be reduced by 90% annually and nitrogen by 13% annually, according to the TMDL for this water resource. Total suspended solids must not exceed 90 mg/L in order to achieve full support of designated uses in the management area.

Miami County State Fishing Lake – To achieve full support of designated uses in the lake, phosphorus loading from nonpoint sources must be reduced by 89% annually to achieve the TMDL limit of 526 pounds per year.

Mound City Lake – According to the TMDL for this water resource, phosphorus loading from nonpoint sources must be limited to 1,012 pounds per year, an annual reduction of 71%.

Protection Goals

For priority water resources in need of protection, the goal is to maintain current water quality levels. More information about water quality conditions for priority water resources in need of protection is available from the KDHE Bureau of Environmental Field Services (see Appendix A for contact information).

Table 4: Priority Water Resources Requiring TMDLs

Lower Marais des Cygnes			
Water Resource	TMDL	Implementation Priority	Annual Pollutant Load Reduction Target
Rivers and Streams:			
Middle Creek	Dissolved Oxygen	High	BOD 22%

Lakes and Wetlands:			
Edgerton City Lake	Eutrophication Atrazine	Medium Medium	Phosphorus 72% Atrazine 58%
Hillsdale Lake	Eutrophication	High	Phosphorus 46%
Marais des Cygnes Wildlife Area	Eutrophication	High	Phosphorus 90% Nitrogen 13%
	Dissolved Oxygen	High	Not specified
	pH	High	Not specified
	Siltation	High	TSS not to exceed 90 mg/L
Miami County State Fishing Lake	Eutrophication	Medium	Phosphorus 89%
	pH		Not specified
Mound City Lake	Eutrophication	Medium	Phosphorus 71%
	Dissolved Oxygen	Medium	Not specified
	Excessive Biomass of Submerged Plants	Medium	Not specified

SOURCES

Kansas Surface Water Register – June 1, 1999
KDHE Bureau of Environmental Field Services
<http://www.kdhe.state.ks.us/pdf/befs/register99.pdf>

Lower Marais des Cygnes Watershed Condition Report
KDHE Watershed Management Section
http://www.kdhe.state.ks.us/nps/wc_reports/10290102.pdf

SECTION 3

LITTLE OSAGE HUC 8 (10290103)

**LITTLE OSAGE WATERSHED (HUC 10290103)
WATERSHED RESTORATION and PROTECTION STRATEGY**

I. WATERSHED SETTING

Location

The Little Osage Watershed is located in East Central Kansas within Anderson, Linn, Allen and Bourbon counties. This watershed is approximately 33.50 square miles. Of these 33 square miles, there are approximately 142.8 stream miles and 37.98 acres of lakes (Figure 7).

Water Resources

This watershed is mostly a drainage basin for the Little Osage River, however, smaller streams and creeks are also abundant throughout the area. The Little Osage River, Clever Creek, Elk Creek and Owl Creek are a few of the larger streams and rivers in the watershed. This watershed is home to a few city and county lakes. Prescott City Lake and Blue Mound City Lake are among the larger lakes within this watershed. (More information about aquifers is available in the Little Osage Watershed Conditions Report in Appendix B.

Land Use

The primary land use in the watershed is grassland that comprises 45% of the watershed. Cropland occupies 31%, forest/woodland 20%, surface water 1%, urban less than 1% and wetland 3% of the watershed. Analyzing the land uses within this watershed helps to understand which land uses might have greater influences on the source of the impairments (Figure 8).

Water Uses

The most common designated uses for streams and rivers in this watershed include aquatic life uses, contact recreation, food procurement, domestic water supply, food procurement, groundwater recharge, irrigation, and livestock. There are approximately seven public water supply wells within the watershed. There are approximately 18 groundwater wells located within this watershed.

Overview of Water Quality

The Little Osage Watershed is ranked 21st in priority for watershed restoration throughout the state. According to the Unified Watershed Assessment, 92% of the total miles of water in this watershed do not meet their designated uses. Approximately 62% of the stream/river segments sampled require TMDL restoration. The primary pollutant concern within this watershed is fecal coliform bacteria.

Currently, Prescott City Lake is the only lake within this watershed requiring a TMDL. The primary pollutant concern is eutrophication.

Information about KDHE monitoring sites, within the watershed, is available from the KDHE Bureau of Environmental Field Services (see Appendix A for contact information). Information about potential pollution sources is included in the Introduction.

II PRIORITY WATER RESOURCES

For the purpose of this report, “priority water resources” is defined as those water resources with the following designated uses: domestic water supply, primary contact recreation, special aquatic life support, and/or food procurement. Priority water resources include those resources in need of restoration and those in need of protection.

Priority water resources in the Little Osage Watershed are summarized in Table 1 and illustrated in Figure 7.

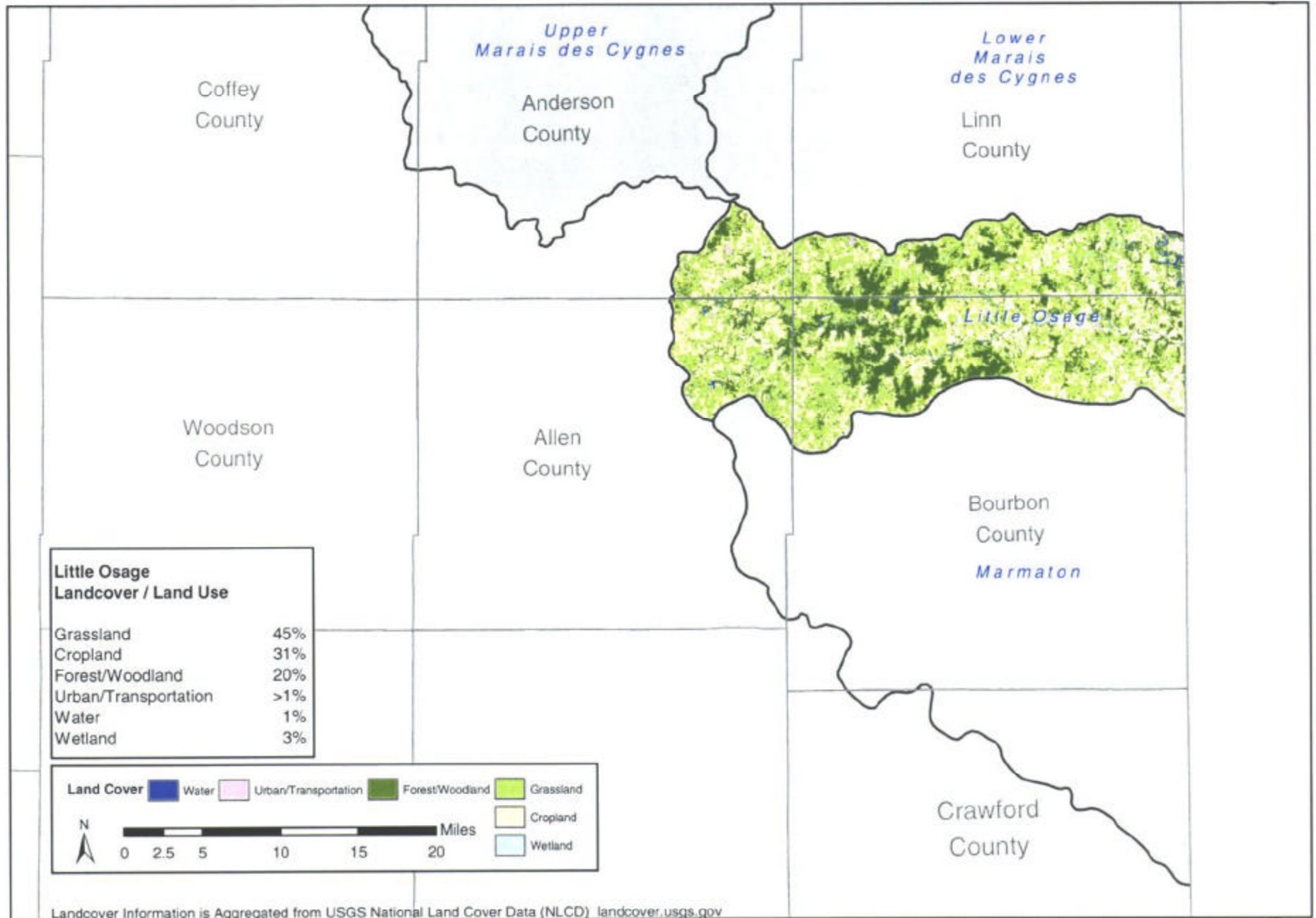


Figure 8

TABLE 5: Priority Water Resources in the Little Osage Watershed

Water Source	Designated Uses	Drinking Water Supply For:
Rivers and Streams		
Little Osage River	SAL, DS, FP, GR, IS, IR, LW, PCR	

Designated Uses	Water Supply Source For:	Drinking Water Supply For:
Lakes and Wetlands		
Prescott City Lake	EAL, DS, IR FP, PCR, SCR	Prescott

III. WATER QUALITY CONDITIONS

Rivers and Streams

Water quality in streams and rivers is generally poor with less than half of the surface water bodies not meeting their designated uses. Approximately 62% of the stream/river segments sampled require TMDL restoration (Figure 9).

The primary pollutant of concern within this watershed is fecal coliform bacteria. Fecal coliform bacteria is present in human and animal waste and serves as an indicator of potential disease causing organisms. Potential sources of bacteria contamination include livestock facilities, streamside feeding of livestock, septic systems, pets and wildlife.

Rivers and Streams in Need of Restoration

Little Osage River - The goal for the Little Osage River will be for improvements which will support Primary Contact Recreation and Secondary Contact Recreation. Implementation of corrective actions and Best Management Practices to address the primary pollutant concern of fecal coliform bacteria, which is an indicator of potential disease causing organisms, will be the endpoint to achieve Kansas Water Quality Standards.

Lakes and Wetlands

Currently, this watershed has only one lake, Prescott City Lake, requiring a TMDL. Prescott City Lake's primary pollutant concern is eutrophication (Figure 2).

Eutrophication is a natural process that creates conditions favorable for algae blooms and excess plant growth. Excess nutrient loading often accelerates this process. Silt decreases water clarity and eventually decreases water storage capacity. Silt can also carries attached phosphorous into the reservoir, which can accelerate eutrophication. More information about potential pollution sources in the Little Osage Watershed is included in the Introduction.

Table 6: Priority Water Resources Requiring TMDLs

Little Osage			
Water Resource	TMDL	Implementation Priority	Annual Pollutant Load Reduction Target
Rivers and Streams:			
Little Osage	Fecal Coliform Bacteria	Medium	Not specified

SOURCES

Kansas Surface Water Register – June 1, 1999
KDHE Bureau of Environmental Field Services
<http://www.kdhe.state.ks.us/pdf/befs/register99.pdf>

Little Osage Watershed Conditions Report
KDHE Watershed Management Section
http://www.kdhe.state.ks.us/nps/wc_reports/10290103.pdf

SECTION 4

MARMATON
HUC 8 (10290104)

MARMATON (HUC 10290104)
WATERSHED RESTORATION AND PROTECTION STRATEGY

I. WATERSHED SETTING

Location

The Marmaton Watershed (HUC 10290104) is comprised of 1,141 square miles and is located on the lower end of the Marais des Cygnes Basin (Figure 9).

Water Resources

The watershed is mostly a drainage basin for the Marmaton River and its tributaries. Bone Creek Reservoir is the largest lake in the watershed. There are also several small city and county lakes in the watershed, including Bourbon County State Fishing Lake, Rock Creek Lake, Fort Scott Lake, and Elm Creek Lake. Ozark Aquifer underlines the majority of the watershed. Alluvial aquifers of the Marmaton River and its tributaries also exist throughout the watershed. More information about aquifers is available in the Marmaton Watershed Conditions Report in Appendix B.

Land Use

The primary land use in the watershed is grassland (considered grazingland for livestock), which comprises 48% of the watershed. Cropland occupies 28% of the watershed, forest/woodland areas 18%, surface water 2%, and urban land 1% and wetlands comprise the remaining 3% of the watershed (Figure 10).

Water Uses

The most common designated uses for streams and rivers in this watershed are aquatic life support and domestic water supply. There are approximately 15 public water supplies within the watershed, many of which draw water from the Marmaton River and its alluvium. The majority of lakes in the watershed are designated for food procurement, aquatic life support, and recreation. There are approximately 47 groundwater wells located within the watershed. Water from these wells is used for domestic use, public water supply, industrial use, groundwater monitoring, and lawn and garden.

Overview of Water Quality

The Marmaton watershed is ranked 17th in priority for watershed restoration throughout the state, according to the Unified Watershed Assessment completed by KDHE in 1998.

Water quality in streams and rivers in the watershed is generally in fair to poor condition. Nearly 62% of total stream miles do not meet designated uses. Approximately 44% of stream/river segments sampled require TMDLs. The primary pollutant concerns in streams and rivers are low levels of dissolved oxygen, eutrophication, ammonia, and nutrients.

Approximately 18% of the watershed's lakes and wetland areas sampled require TMDLs. The primary pollutant concern for lakes within the watershed is eutrophication.

Information obtained from monitoring sites within watershed is available from the KDHE Bureau of Environmental Field Services (see Appendix C for contact information). Information about potential pollution sources is included in the Introduction.

II. PRIORITY WATER RESOURCES

For the purposes of this report, "priority water resources" is defined as surface water resources with the following designated uses: domestic water supply, primary contact recreation, special aquatic life support, and/or food procurement. Priority water resources include resources in need of restoration and those in need of protection.

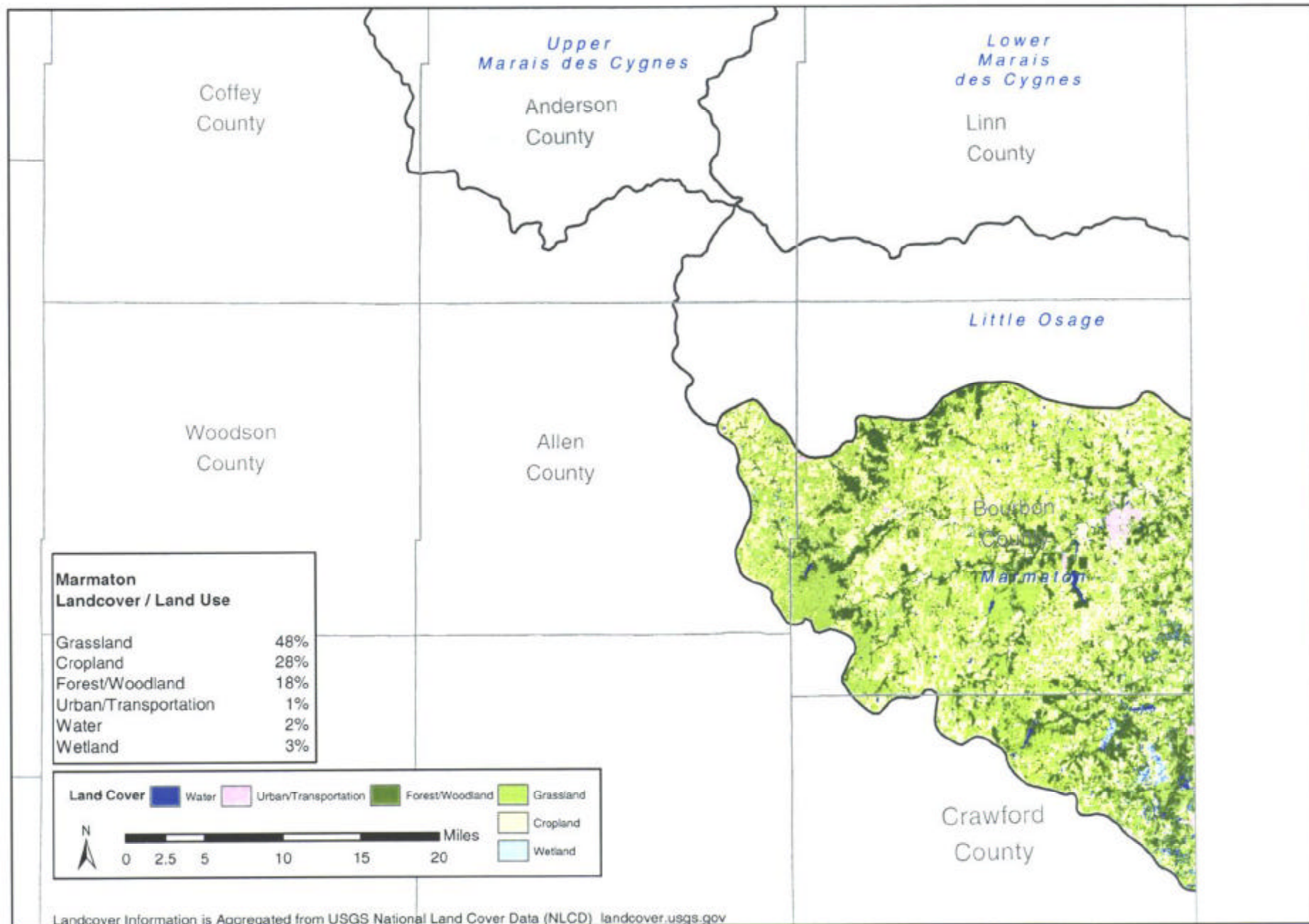


Figure 10

Priority water resources in the Marmaton Watershed are summarized in Table 1 and illustrated in Figure 9.

TABLE 7: Priority Water Resources in the Marmaton Watershed

Water Resource	Designated Uses	Drinking Water Supply For:
Rivers and Streams:		
Cedar Creek	EAL, DS	
Marmaton River (includes alluvial aquifer)	SAL, PCR, DS, FP, GR, IW, IR, LW	Fort Scott, Uniontown, Bourbon RWD 2
Mill Creek	EAL, FP	
Paint Creek	EAL, FP	
Lakes and Wetlands:		
Bone Creek Reservoir	EAL, PCR, DS, FP, IS	PWWSD 11, Arcadia, Arma, Cherokee, Cherokee RWD 6, Chicopee, Columbus, Crawford RWD 2 and 6, Girard, Mulberry, Weir, West Mineral
Bourbon County State Fishing Lake	EAL, PCR, FP	
Bronson City Lake	EAL, PCR, DS, FP, IS	Bronson
Rock Creek Lake	EAL, FP, LW	
Elm Creek Lake	EAL, PCR, FP	
Fort Scott City Lake	EAL, PCR, DS, FP, IS	City of Fort Scott, Bourbon RWD 2
Frisco Lake	EAL, FP	
Gunn Park East Lake	EAL, FP	
Gunn Park West Lake	EAL, FP	

Key:

SAL – Special Aquatic Life Support
EAL – Expected Aquatic Life Support
PCR – Primary Contact Recreation
SCR – Secondary Contact Recreation
DS – Domestic Water Supply
FP – Food Procurement
GR – Groundwater Recharge
IW – Industrial Water Supply
IR – Irrigation
LW – Livestock Watering

III. WATER QUALITY CONDITIONS**Rivers and Streams**

Water quality in streams and rivers in the Marmaton Watershed is generally in fair to poor condition. Nearly 62% of total stream miles do not meet designated uses. Approximately 44% of stream/river segments sampled require TMDLs (Figure 9).

The primary pollutant concerns for the watershed's streams and rivers are low levels of dissolved oxygen, eutrophication, ammonia, and nutrients. Of these pollutant concerns, low dissolved oxygen is by far the most prevalent. Dissolved oxygen levels can be lowered by a number of environmental factors including high water temperature and organic enrichment. Many Kansas streams are bordered by a limited amount of riparian area. These riparian areas are vital for shading streams and rivers, which helps lower the water temperature and increase dissolved oxygen levels. Low dissolved oxygen levels also typically coincide with an abundance of algae, which is often the result of excess nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up the oxygen in the stream or river water column. Potential sources of excess nutrients include row crop agriculture, feedlots, urban/suburban runoff, wastewater treatment facilities, septic systems, and wildlife.

Rivers and Streams in Need of Restoration

Marmaton River – Aquatic life in certain segments of the river is partially impaired due to excessive nutrients and low levels of dissolved oxygen. Overall, the average concentration of nutrients (phosphorus, ammonia, and nitrate) in the Marmaton River Watershed tends to be high. The development of the TMDL relies on the narrative (qualitative) water quality standards pertaining to nutrients and total suspended solids. However, there is no direct link between the pollution tolerance of aquatic life and the levels of nutrients and total suspended solids. Stream flows, adequate habitat, and stream modification may also contribute to higher levels of pollution tolerance. Decreased pollutant loads (and the corresponding improvement in water quality) should result in the ability of the river to fully support aquatic life. Sources of nutrients within the watershed may include point sources (primarily municipal wastewater treatment plants) that are being addressed through NPDES permits, and nonpoint sources (urban and rural runoff). Aquatic life in certain segments of the river is also impaired due to low levels of dissolved oxygen. A comparison of the upper reaches of the river in the Little Osage Watershed with the lower reaches in the Marmaton Watershed indicated a significant nutrient load is being added to the river and is likely the driving factor causing impairments. Some organic enrichment may be associated with environmental background levels, including contributions from wildlife and streamside vegetation. More information about the TMDLs for the Marmaton River is available in Appendix C.

Lakes and Wetlands

Approximately 18% of the watershed's lakes and wetland areas sampled need TMDLs. The primary pollutant concern for lakes within the watershed is eutrophication (Figure 2).

Eutrophication is a natural process that creates conditions favorable for algae blooms and excess plant growth. Excess nutrient loading often accelerates this process from the watershed. Low dissolved oxygen levels typically coincide with an abundance of algae, which may be caused by excess nutrients. An abundance of algae causes the population of decomposers to increase, which in turn uses up the

oxygen in the stream or river. Nutrients can come from a number of sources including wastewater treatment plants, confined animal feeding operations, septic systems, row crop agriculture, urban/suburban development, and wildlife. Based on land uses in the Marmaton Watershed, it appears that row crop agriculture and livestock grazing may be significant sources of excess nutrients. However, urban/suburban development and septic systems may also contribute significant amounts of nutrients. More information about potential pollution sources in the watershed is included in the Introduction.

Lakes and Wetlands in Need of Restoration

Bronson City Lake – All of Bronson City Lake’s designated uses are impaired to a degree by eutrophication. The total phosphorus concentrations in the lake are high and have increased dramatically since 1992. KDHE has determined that phosphorus is the limiting factor. The watershed around Bronson City Lake has a moderate to high potential for nonpoint source pollutants. Phosphorus from animal waste is a primary contributing factor. Thirty percent of land around the lake is grassland and the grazing density of livestock is high. One source of phosphorus within Bronson City Lake is probably runoff from agricultural lands where phosphorus has been applied. Leaf litter, atmospheric phosphorus, and geological formations (i.e., soil and bedrock) may also contribute to phosphorus loads. More information about the TMDL for Bronson City Lake is available in Appendix C.

Elm Creek Lake – All of Elm Creek’s designated uses are impaired to a degree by eutrophication. The lake is considered “hypereutrophic”, meaning that the lake is extremely or very highly eutrophic. An assessment conducted by KDHE suggests that agricultural uses in the watershed contribute to the hypereutrophic state of the lake. The watershed has a moderate to high potential for nonpoint source pollution. One source of phosphorus within the lake is runoff from agricultural lands where phosphorus has been applied. Phosphorus from animal waste, atmospheric phosphorus, and geological formations (i.e., soil and bedrock) may also contribute to nutrient loads. More information about the TMDL for Elm Creek Lake is available in Appendix C.

IV. WATER QUALITY GOALS

The general goals associated with each priority water resource are to restore (for those water resources with a TMDL) or maintain (for those water resources in need of protection) water quality to fully support designated uses.

Restoration Goals

Rivers and Streams

Marmaton River — According to the TMDL for this water resource, the goal is to achieve the Kansas Water Quality Standard for dissolved oxygen to fully support aquatic life. To achieve this standard, an annual biochemical oxygen demand reduction of 54% is required. More information about the TMDL for the Marmaton River is available in Appendix C.

Lakes and Wetlands

Bronson City Lake – According to the TMDL for this water resource, a 51.4% reduction in total phosphorus is necessary to meet the level of eutrophication that will support designated uses.

Elm Creek Lake – According to the TMDL for this water resource, a 64% reduction in total phosphorus is necessary to meet the level of eutrophication that will support designated uses.

Protection Goals

For priority water resources in need of protection, the goal is to maintain current water quality levels. More information about water quality conditions for priority water resources in need of protection is available from the KDHE Bureau of Environmental Field Services (see Appendix B for contact information).

Table 8: Priority Water Resources Requiring TMDLs

Marmaton			
Water Resource	TMDL	Implementation Priority	Annual Pollutant Load Reduction Target
Rivers and Streams:			
Marmaton River	Dissolved Oxygen	High	BOD 54%
	Nutrients/BOD	High	Not specified
Lakes and Wetlands:			
Bronson City Lake	Eutrophication	Medium	Phosphorus 51%
Elm Creek Lake	Eutrophication	Low	Phosphorus 64%

SOURCES

Kansas Surface Water Register – June 1, 1999
KDHE Bureau of Environmental Field Services
<http://www.kdhe.state.ks.us/pdf/befs/register99.pdf>

Marmaton Watershed Condition Report
KDHE Watershed Management Section
http://www.kdhe.state.ks.us/nps/wc_reports/10290104.pdf

SECTION 5

ACTION PLAN
FOR
MARAIS des Cygnes
BASIN

Action Plan to Implement Goals of Marais Des Cygnes Basin Watershed and Restoration Plan

	Actions	Implementation Schedule	* Estimated Cost	**Funding Sources	*** Partnership Responsibility
GOAL A:	Implement strategies to reduce pollution in TMDL targeted areas				
Action #1	Remove winter feeding sites in proximity to streams.	2003 - 2007	\$2,390,988.00	WRCSP, NPSP EQIP, RFFP, CWNP KAWS	KDHE, CD, NRCS KSU, EPA, SCC KRC, Landowners KAWS, KRC
Action #2	Install proper livestock waste storage and implement nutrient management plans.	2003 - 2007	\$4,020,000.00	WRCSP, NPSP, EQIP RFFP, CWNP	KDHE, NRCS, KSU KRC, SCC, KRC Landowners
Action #3	Install and improve pasture management practices and develop improved grazing management plans to prevent overgrazing.	2003 - 2007	\$1,646,971.00	EQIP, WRCSP, NPSP KAWS, CWNP	NRCS, SCC, KLA KSU, Landowners KDHE, KAWS, KRC
Action #4	Stabilize streambanks and restore riparian vegetation along targeted stream segments using forest & grass buffer strips, reduce activities within riparian areas and promote grass terraces near riparian areas.	2003 - 2007	\$1,667,715.00	EQIP, NPSP RPP, BIP, WHIP, CRP KAWS	NRCS, CD, SCC KSU, KFS, USF&WS KAWS, Landowners KDWP
Action #5	Implement soil sampling to recommend appropriate fertilizer applications on cropland, expand conservation tillage and contour farming to minimize cropland erosion and insure that labeled application rates of chemical fertilizers are followed.	2003 - 2007	\$7,484,292.00	NPSP, EQIP, RFFP	CD, NRCS, KCGA, KCSPA, KSU Landowners

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Action #6	Establishment of structural and non-structural practices on cropland using best management practices to improve and protect water quality.	2003-2007	\$19,213,578.00	WRCS, EQIP, NPSP	CD, NRCS, KCGA KGSPA, Landowners
Action #7	Initiate Forestry Cooperative or Association Project to help maintain or establish riparian tree cover, reduce soil erosion and provide wildlife habitat	2003- 2007	\$400,000.00	FLEP, RWP, BIP WHIP, KDHE, EPA	Lake Region RC&D KFS, KDHE, CD NRCS, Landowners
Action #8	Create wetlands as an efficient low cost treatment practice to reduce streambank erosion, recharge groundwater supplies, and to filter and collect nonpoint source nutrients and sediment.	2003 - 2007	\$350,000.00	EQIP, WRCSP, NPSP, WHIP	SCC, KDWP, NRCS CD, KDHE, KWO EPA, Corps of Eng. KAWS, USF&WS Landowners, KDWP
Action #9	Insure proper on-site waste system operations in proximity to main streams.	2003 - 2007	\$19,181,992.00	NPSP, LEPP, Farm *A* Syst Home*A:*Syst	KDHE, CD, KWO KSU, Landowners
GOAL B	Carry out Technical Assistance, Information and Education Programs for Water Quality.				
Action #1	Educate livestock producers on pasture management and improved grazing systems.	2003 - 2008	\$225,000.00		CD, NRCS, KSU Extension KFB, KLA KDHE, KAWS
Action #2	Coordinate with USDA/NRCS Environmental Quality Incentive Program in providing educational, technical assistance to agricultural producers.	2003 - 2008	\$458,000.00	EQIP	NRCS, CD Hillsdale WQ Project Lake Region RC&D

Action #3	Provide educational assistance in urban settings on practices geared to minimize chemical fertilizer impact to streams.	2003 -2008	\$225,000.00		NRCS, CD, KSU Hillsdale WQ Project KACEE, Streamlink
Action #4	Provide incentives and education to landowners on failing on-site waste systems.	2003 - 2008	\$360,000.00	SCC, KDHE, LEPP NPSP,	KDHE, CD SCC
Action #5	Provide educational opportunities through Kansas Environmental Leadership Program (KELP) and Kansas Streamlink.	2003 - 2008	\$225,000.00	KELP, Project Wet	KACEE, KDHE KSU Extension Streamlink
Action #6	Use watershed specialists to provide one-on-one and group awareness of best management Practices.	2003 - 2008	\$360,000.00	KSU	KSU Extension Hillsdale WQ Project Lake Region RC&D
Action #7	Conduct demonstrations to educate landowners on the value of riparian and wetland areas.	2003 - 2008	\$225,000.00	SCC, KAWS, NRCS	KAWS, CD, NRCS KDWP, SCC
Action #8	Build strong partnerships between all public and private authorities relevant to this plan to achieve environmental equity and promote effective implementation and promote effective watershed basin planning.	2003 - 2008	\$400,000.00	KDHE, KSU, SCC	Lake Region RC&D CD, NRCS, KWO Hillsdale WQ Project KFS

* Estimated costs provided by State Conservation Commission High Priority TMDL Needs for the Marais des Cygnes Basin

**** Funding Sources**

WRCSP	Water Resources Cost Share Program
NPSP	Non-Point Source Pollution Program
EQIP	Environmental Quality Incentive Program
CWNP	Clean Water Neighbor Program
RPP	Riparian Protection Program
BIP	Buffer Initiative Program
WHIP	Wildlife Habitat Incentive Program
CRP	Conservation Reserve Program
LEPP	Local Environmental Protection Program
KELP	Kansas Environmental Leadership Program
RFFP	River Friendly Farm Program
FLEP	Forest Land Enhancement Program

*****Partnerships**

KDHE	Kansas Department of Health & Environment
SCC	State Conservation Commission
CD	Conservation Districts
NRCS	Natural Resources Conservation Service
RC&D	Lake Region Resource Conservation and Development
HWQP	Hillsdale Water Quality Project
KSU	Kansas State University
KFS	Kansas Forest Service
KWO	Kansas Water Office
COE	Corps of Engineers
EPA	Environmental Protection Agency
KFB	Kansas Farm Bureau
KRC	Kansas Rural Center
KCGA	Kansas Corn Growers Association
KGSPA	Kansas Grain Sorghum Producers Association
KLA	Kansas Livestock Association
KAWS	Kansas Alliance for Wetlands and Streams
KACEE	Kansas Association of Conservation and Environmental Educators
KDAP	Kansas Department of Wildlife and Parks
USFWS	United States Fish and Wildlife Service
FSA	USDA Farm Service Agency

SECTION 6

APPENDICES

LIST OF APPENDICES

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 - III - Kansas Water Office 2005 Draft Kansas Water Quality Policy**

APPENDIX A

**LIST OF ORGANIZATIONS
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APPENDIX B

**WATERSHED CONDITIONS
REPORTS**

APPENDIX C

STREAM and LAKE TMDLs for the MARAIS DES CYGNES BASIN

APPENDIX D

DRAFT 2005 KANSAS WATER PLAN STATE OF KANSAS 2002 STATUS REPORT KANSAS WATER OFFICE 2005 DRAFT WATER QUALITY POLICY